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SUPERSEDING
FAA-E-2313, 12/22/67

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

RF PREAMPLIFIER

1. SCOPE

1.1 Scope.- The equipment specified herein consists of a broadband (118 to 144 MHz and 225 to 400 MHz) solid state preamplifier with two separate inputs, one for each frequency range, and a power supply. Each of the two preamplifier inputs will be connected to an antenna of its particular frequency range. The output will be connected to a single transmission line which connects the antennas to the receiver of a direction finding system through a coaxial power splitter.

2. APPLICABLE DOCUMENTS

2.1 FAA specifications.- The following FAA specifications, of the issues specified in the invitation for bids or request for proposals, form a part of this specification:

FAA-D-1272	Instruction Booklet, Electronic Equipment
FAA-G-2100/1	Electronic Equipment, General Requirements; Part 1, Basic Requirements for all Equipment
FAA-G-2100/3	Part 3, Requirements for Equipment Employing Semiconductor Devices

FAA-G-2100/4 Part 4, Requirements for Equipment Employing Printed Wiring Techniques

FAA-G-2100/5 Part 5, Requirements for Equipments Employing Microelectronic Devices

(Copies of this specification, and of the applicable FAA specifications and drawings, may be obtained from the Federal Aviation Administration, Washington, D. C. 20590, ATTN: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also request should state the contract involved or other use to be made of the requested material.)

2.2 Military specification.- The following Military specification, of the issue specified in invitation for bids or request for proposals, forms a part of this specification:

MIL-HDBK-217 Reliability Stress and Failure Rate data for Electronic Equipment

(Information on obtaining copies of Military specifications, standards, and handbooks is given in the Supplement to FAA-G-2100.)

3. REQUIREMENTS

3.1 Equipment supplied by the contractor.- Each equipment supplied by the contractor shall be complete in accordance with all specification requirements and shall include the items tabulated below. Instruction booklets shall be supplied in accordance with FAA-D-1272, in quantities specified in the contract schedule.

a. DF preamplifier (3.3)

b. Coaxial power splitter (3.14)

3.2 Definitions

3.2.1 Power source.- The equipment shall operate from a single phase two wire AC power source. The design center voltage (1-3.2.21, FAA-G-2100/1) shall be 120 V. In lieu of FAA-G-2100/1, paragraph 1-3.2.23, the voltage limits shall be 105 to 130 V.

3.2.2 Ambient conditions.- The ambient conditions shall be Environment III (1-3.2.23 of FAA-G-2100/1) with the exception that the requirements for ice loading and wind conditions shall not apply.

3.3 General design requirements.- The RF preamplifier shall meet the requirements of the following subparagraphs.

3.3.1 Solid-state design.- The use of semiconductor devices (FAA-G-2100/3) instead of electron tubes is required for all circuit applications. All microelectronic devices used must be in accordance with FAA-G-2100/5.

3.3.2 Reliability.- The amplifier shall have design reliability to provide expected mean-time-between failures (MTBF) of not less than 10,000 hours with all calculations based on methods and data from MIL-HDBK-217.

3.4 Frequency range.- The frequency of the preamplifier shall cover the ranges of 118 to 144 MHz and 225 to 400 MHz.

3.5 RF input circuits.- Two RF input circuits shall be designed and provided for connection to 50-ohm unbalanced flexible coaxial cables. One input circuit shall cover the frequency range of 118 to 144 MHz, the other input shall cover 225 to 400 MHz, and both shall be marked accordingly.

3.5.1 Input circuit protection.- The input circuits shall be designed to withstand (1) two watts of CW RF power continuously, over the specified frequency ranges (3.4), without damage to any part or degradation of performance, and (2) pulses of 50 volts either polarity at a repetition rate up to 3200 pulses per second.

3.5.2 Voltage standing wave ratio.- The voltage standing wave ratio as measured at either input connector with the other terminated by a 50 ohm resistive load shall not exceed 1.5 to 1 over the specified frequency ranges (3.4).

3.5.3 Input connectors.- The input receptacles shall be type UG-58A/U. Type N mating plugs with captivated pins shall also be furnished.

3.6 Output circuit.- A single unbalanced RF output circuit shall be designed for connection to a 50 ohm unbalanced flexible coaxial line.

3.6.1 Output connector.- The output receptacle shall be type UG-58A/U. Mating plug type N with a captivated pin shall be furnished. The amplifier enclosure shall be marked OUTPUT adjacent to the connector.

3.6.1.1 Continuity.- The resistance between the input and output connector shields shall not be greater than 0.2 ohms.

3.7 Amplifier performance.- The RF preamplifier shall meet the performance requirements of the following subparagraphs over the specified frequency ranges (3.4).

3.7.1 Gain.- The amplifier gain shall be at least 37 dB with an input signal, within the range of 5 uV to 5 mV, applied to either input with the other input terminated by a 50 ohm resistive load.

3.7.2 Gain flatness.- With a constant signal applied to either input in accordance with paragraph 3.7.1, the gain shall not vary more than $\pm$1 dB over the entire frequency ranges.

3.7.3 Noise figure.- The noise figure shall be less than 5 dB.

3.7.4 Output level.- The output level shall be greater than +7 dBm at the 1 dB gain compression point.

3.7.5 Harmonic distortion.- The level of each harmonic shall be down 40 dB or more referred to the level of the fundamental frequency, for outputs up to 0 dBm.

3.7.6 Phase linearity.- The phase linearity shall be ±5 degrees or better.

3.8 DC blocking.- Circuitry shall be provided to block DC voltages up to 50 volts from the preamplifier input.

3.9 Power supply.- The amplifier shall operate from a single power supply. The amplifier and power supply shall be isolated from the 120 V AC power source by means of a transformer (1-3.6.7, FAA-G-2100/1). No transformer taps shall be provided to permit adjustments for variation in AC line voltage. No batteries or bias cells shall be used.

3.9.1 AC line receptacle and power cord.- AC line receptacles and power cord shall be furnished in accordance with FAA-G-2100/1, paragraph 1-3.6.6. A detachable power cord is not required. The power cord shall be four feet in length.

3.10 Fuse.- An indicating-type fuseholder shall be furnished in accordance with paragraphs 1-3.7.1 and 1-3.7.8 of FAA-G-2100/1.

3.11 Nameplate.- The nameplate for the preamplifier shall be in accordance with paragraph 1-3.13 of FAA-G-2100/1. The unit's name shall be: RF PREAMPLIFIER.

3.12 Semiconductors.- All semiconductor devices (diodes, transistors) shall be of the silicon type. Connections to the semiconductors shall be soldered except where stud mounting terminals are provided thereon (3-3.2 of FAA-G-2100/3).

2.12.1 Transistors.- In addition to circuit protection requirements of 1-3.7 and subparagraphs of FAA-G-2100/1, protection of transistors and associated circuits from damage due to overloads or excessive heating shall be provided.

3.13 Construction.- The RF preamplifier and power supply shall be mounted on a 0.063 inch aluminum mounting plate having dimensions not exceeding five inches by ten inches. The unit shall not exceed five inches in height. A 3/16 inch hole in each corner of the plate shall be provided for mounting. The over-all size of the unit shall be as small as practicable in keeping with accessibility of components (parts).

3.13.1 Finish.- The finish of the unit shall be in accordance with 1-3.8, FAA-G-2100/1.

3.14 Coaxial power splitter.- A coaxial power splitter shall be furnished with each RF preamplifier in accordance with the following subparagraphs. The output of the preamplifier is terminated in a coaxial transmission line. A coaxial splitter is required to connect the transmission line to the separate VHF and UHF inputs of the DF receiver.

3.14.1 Input and outputs.- One input and two output circuits shall be designed for connection to 50 ohm unbalanced flexible coaxial cables. Each output shall contain a coaxial step attenuator with at least 12 dB of attenuation in 1 dB steps with 0.5 dB accuracy. Changing the attenuation shall be accomplished by simple knob rotation.

3.14.2 Insertion loss.- The insertion loss of the coaxial power splitter shall not exceed 4 dB as measured from the input to each output.

3.14.3 Connectors.- The input and output receptacles shall be type UG-58A/U. A type N mating plug with a captivated pin shall be furnished for each receptacle.

3.14.4 Voltage standing wave ratio.- The voltage standing wave ratio as measured at either output connector with the other terminated by a 50 ohm resistive load shall not exceed 1.5 to 1 over the specified frequency ranges (3.14.5).

3.14.5 Frequency range.- The coaxial power splitter shall meet all the requirements in the frequency ranges of 118 to 144 MHz and 225 to 400 MHz.

3.14.6 Circuit protection.- The coaxial power splitter shall be designed to withstand two watts of CW RF power continuously over the specified frequency ranges (3.14.5).

3.14.7 Continuity.- The resistance between the input and output connector shields shall not be greater than 0.2 ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- See Section 1-4 of Specification FAA-G-2100/1.

4.2 Design qualification tests.

4.2.1 Service conditions.- The following design qualification tests shall be made while subjecting the equipment (amplifier, power supply and coaxial power splitter) to the test procedure described under 1-4.12 of FAA-G-2100/1. Each of the following tests shall be conducted at 105, 120 and 130 V AC power inputs.

Test	Frequency (MHz)	Paragraph
4.2.1.1 RF preamplifier		
RF input circuits (both)	118, 144, 225, 300, 400	3.5
Input circuit protection	144, 400	3.5.1
VSWR	118, 144, 225, 300, 400	3.5.2
Output circuit	118, 144, 225, 300, 400	3.6
Gain	118, 144, 225, 400	3.7.1
Phase linearity	144, 400	3.7.6
4.2.1.2 Coaxial power splitter		
Input and Outputs (both) and attenuator accuracy	118, 144, 225, 300, 400	3.14.1
Insertion loss	144, 400	3.14.2
VSWR	118, 144, 225, 300, 400	3.14.4
Circuit protection	144, 400	3.14.6

4.2.2 Normal test conditions.- The following design qualification tests shall be made under normal test conditions.

Test	Frequency (MHz)	Paragraph
4.2.2.1 RF preamplifier		
Continuity		3.6.1.1
DC blocking		3.8
4.2.2.2 Coaxial splitter		
Continuity		3.14.7

4.3 Type tests

4.3.1 Service conditions.- The following type tests shall be made while subjecting the equipment (amplifier, power supply and coaxial power splitter) to the test procedure described under 1-4.12 of FAA-G-2100/1. Each of the following tests shall be conducted at 105 and 130 V power inputs.

Test	Frequency (MHz)	Paragraph
Gain flatness	118 to 144, 225 to 400	3.7.2
Noise figure	118, 144, 225, 400	3.7.3

Test	Frequency (MHz)	Paragraph
Output level	118, 144, 225, 300, 400	3.7.4
Harmonic distortion	144, 225, 400	3.7.5

4.4 Production tests.- The following production tests shall be made under normal test conditions.

Test	Frequency (MHz)	Paragraph
4.4.1 RF preamplifier		
VSWR	144, 400	3.5.2
Continuity		3.6.1.1
Gain	144, 400	3.7.1
Gain flatness	118 to 144, 225 to 400	3.7.2
Noise figure	144, 400	3.7.3
4.4.2 Coaxial splitter		
VSWR	144, 400	3.14.4
Continuity		3.14.7

4.5 Output termination.- All tests shall be made with the equipment output connected to a 50 ohm resistive load.

4.6 Application of input signal.- All test voltages applied to the input of the equipment shall be unmodulated RF voltages at the level specified in paragraphs 3.5.1, 3.7.1 and 3.14.6.

5. PREPARATION FOR DELIVERY

5.1 General.- Packing and marking shall be in accordance with FAA-G-2100/1. One coaxial power splitter shall be packaged with each preamplifier. Unless otherwise specified in the contract, each preamplifier shall be individually packed for domestic reshipment.

6. NOTES

6.1 Notes.- The preamplifier will be installed in a weather proof box at the base of the antenna.

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